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The Extensible Markup Language - New opportunities in the area of EDI

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Abstract:

Only about 5% of the companies which could profit from EDI actually use it. The main reason is that especially small and medium-sized enterprises (SMEs) try to avoid the considerable setup- and operating costs of traditional EDI solutions. We demonstrate how new emerging network technologies such as XML and Java can open communications networks and shape the way businesses can interact with one another. Together with our partner Lufthansa AirPlus we developed an XML-based WebEDI solution that aims at lowering setup and running costs, opening EDI networks to SMEs and enabling more dynamic business partnerships. The XML-based architecture of the solution makes a simple support of different standards possible. In a very efficient and flexible way any transaction content can be altered and adapted to different needs because semantics and structure are no longer hard-coded part of the application but of the exchanged XML-document.

I INTRODUCTION

For more than 20 years, companies have been using Electronic Data Interchange (EDI) to transmit structured business documents like orders or invoices electronically. As opposed to paper-based communication, EDI is designed to make communication between different systems possible without media discontinuities. But although there undoubtedly is large savings potential, the use of EDI is by far not as widespread as one could expect. Segev et al. estimate that only about 5% of the companies which could profit from its use actually use EDI [Segev/Porra/Roldan 1997]. The main reason is that especially small and medium-sized enterprises (SMEs) try to avoid the considerable setup- and operating costs of traditional EDI solutions. In addition, the variety of different industry-specific and national EDI standards makes it difficult for businesses to decide which standard to use. Therefore, the use of EDI is mainly reserved for large companies, and a current empirical analysis shows that one of the main reasons for the introduction of EDI is usually pressure from larger business partners, which is often called "gun-to-the-head-EDI" [Westarp/Weitzel/Buxmann/König 1999].

It is the goal of this article to demonstrate a vision of how EDI in the context of new emerging network technologies such as XML and Java can open communications networks and shape the way businesses can interact with one another.

In section 2 we will present an overview of typical costs and benefits associated with traditional EDI. This is the basis for considering the use of the Internet and new surrounding technologies for conducting business to business communication in section 3. Especially for SMEs, a comparably low-cost WebEDI solution can reduce entry barriers to business networks of larger enterprises or increase the chance to remain in existing relationships.

In section 4 we show how the use of innovative network technologies such as XML in combination with Java might lower implementation and operating costs enabling small and medium sized companies to participate in EDI networks. Together with our partner Lufthansa AirPlus we developed an XML-based WebEDI solution that aims at lowering setup and running costs, opening EDI networks to SMEs and enabling more dynamic business partnerships. The starting point for this development was the attempt to develop a solution which can process any data format, especially the different EDI standards, but is still flexible enough to be used by SMEs. This also means that the customizing to the respective inhouse-system has to be as simple as possible.

II TRADITIONAL EDI

Electronic Data Interchange (EDI) is the business-to-business exchange of electronic documents in a standardized machine-processable format. EDI enables partners to electronically exchange structured business documents, such as purchase orders and invoices, between their computer systems. EDI is a means of reducing the costs of document processing and, in general, to achieve strategic business advantages made possible by shorter business process cycle times.

In general, direct benefits of using EDI result from decreased information costs due to cheaper and faster communication. In addition, avoiding media discontinuities eliminates errors due to re-keying of data. The immediate availability of data allows an automation and coordination of different business processes, e. g. enabling just in time production. Other reasons discussed in the literature on EDI why EDI is implemented in enterprises is to offer better service to the customers [Emmelhainz 1993; Marcella/Chan 1993, 5-6]. It is also common that especially smaller companies are forced to implement the EDI standard of a big partner by threat of giving up the business partnership otherwise, sometimes described as "gun-to-the-head-EDI" [Tucker 1997; Marcella/Chan 1993, 7].

An empirical study we conducted in the summer of 1998 shows that about 52% of the responding enterprises in

Germany and about 75% in the US use EDI technology to transfer structured business data. In average, German enterprises use EDI with 21% of their business partners, while it is 30% in the US. With these business partners, 38% of the revenue is realized in Germany and 40% in the US. This confirms the hypothesis that EDI is primarily applied with important customers. It also seems that EDI plays a more important role in the United States than it does in Germany [Westarp/Weitzel/Buxmann/König 1999].

Implementation costs for EDI systems consist of costs for hard- and software, possibly for an adaptation of in-house software, external consulting and the reengineering of business processes. The costs for restructuring internal processes are difficult to quantify and are often underestimated when anticipating the implementation costs of an EDI system. According to the U.S. Chamber of Commerce, the costs for a typical initial installation of an EDI system average at least 50.000 US-Dollars [Waltner 1997]. In addition, these systems are often only compatible with one EDI standard. If an EDI connection is to be established with another business partner, and this potential partner uses a different EDI standard, it becomes necessary to either implement a new EDI system or to expand the existing system to this new standard. Both measures induce significant costs. In order to enable communication between the EDI systems of companies, so-called Value Added Networks (VANs) are used, which cause additional expenses. The charges for using the VAN depend on the size and the frequency of the data transfers as well as the transfer time [Emmelhainz 1993, 113-116]. A company with about 25,000 EDI messages would pay its VAN-Provider something between 14,000 and 25,000 US-Dollars a month [Curtis 1996].

A case study conducted with 3Com reveals an insight into the costs and benefits associated with EDI [Westarp/Weitzel/Buxmann/König 1999]. Mainly driven by the request of strong US business partners, 3Com implemented an EDI solution based on the ANSI X12 standard in 1995. Because of the rapid increase of the data volume, especially driven by the recent acquisition of U.S. Robotics, the EDI solution was moved from PC to a Unix platform. For the data transfer, 3Com uses a private VAN by IBM.

The start up costs for the EDI solution were less than $25,000 (including the first year of VAN service) since existing technical and human resources were used.

In order to establish an EDI Operations department, new personnel was hired. In addition, the technical infrastructure was upgraded, installing a new Unix translator for $100,000.

The setup of a new trading partner for EDI at 3Com takes about 2-3 days of a programmer's work.

A new transaction setup, like adding a certain document to the existing set of an EDI partnership, takes about 8 working days for a programmer (which is rather low compared to an industry average of about 2 weeks), and the mapping takes about $1,140.

The annual costs of running the solution are estimated at $350,000 for personnel, $36,000 for the data transmission (VAN services), and about $17,000 for additional external services, such as software license agreements and outside contracting consultants. 3Com also sets aside a significant portion of the budget for continuing education and professional conferences.

Compared to the benefits, the costs of the EDI solution seem to be reasonable. At 3Com, the costs of manually processing an order process are calculated at $38 compared to $1.35 using EDI. This sums up to estimated savings of $750,000 in sales order and invoice processing. Taking the reduction of data entry errors, efficiency increases due to better warehouse management, and the reduction of processing delays into account, the EDI Operations department estimates overall savings of $1.3 million. These figures are expected to increase dramatically next year since 3Com is in the middle of consolidations due to the merger with U.S. Robotics. At the moment the EDI systems of the two companies are in the process of integration.

III EDI OVER THE INTERNET

The case of 3Com shows that many EDI systems are likely to be Internet-based in the future. The results of our empirical study confirm this assumption. While currently only very few enterprises use WebEDI, more than 50 percent of the enterprises in both countries plan to implement this technology in the future.

A first step to the reduction of costs of EDI solutions is the use of the Internet with its existing communication infrastructure as a means of transportation for EDI messages. While the costs for using VAN's lines are often defined by the number of sent messages or by the number of transmitted characters, there is no such calculation on the Internet. The advantage of the Internet for its users is so great, that 3Com, for example, expects to handle almost 100% of all EDI traffic over the Internet within the next five years. For the 25,000 EDI messages mentioned above, transportation over the Internet would cost only about 1,920 US-Dollars [Curtis 1996].

A number of different communication protocols can be used for the transfer of EDI messages over the Internet. Depending upon the task, the exchange can be made via FTP (File Transfer Protocol), HTTP (Hypertext Transfer Protocol) or SMTP (Simple Mail Transfer Protocol), while the data are encoded either with PGP (Pretty Good Privacy), S/MIME (Secure Multipurpose Internet Mail Extension) or SSL (Secure Socket Layer). Low cost in combination with the large number of emerging technologies for the Internet may now make a considerable contribution to the increase of EDI users and especially allow SMEs to participate in EDI networks.

While at first sight the already available EDI-over-the-Internet solutions address the problem of high up-front and operating costs at least on the client side, there are serious drawbacks. GEIS (GE Trade Web Service), for instance, charge up to $6 per document, which some consider "noncompetitive" [Densmore 1998]. More important, WebEDI is mostly no more than an HTML-front-end to a shopping system. A user manually enters data into a form using a webbrowser as communication interface. Thus, there is no machine-to-machine connection and no way the client, i. e. the small partner, can import the EDI data into his inhouse systems.

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The obvious advantage of using the Web as a medium for EDI communication is that the only (client side) prerequisite is an Internet connection and a webbrowser. All communication uses the ubiquitous HTTP-protocol. Security issues can be addressed by using SSL, for example. Thus, all required infrastructure is most probably almost anywhere available without forcing the partners to invest hefty amounts of money. In this context, form-based EDI proves to be a good idea for large companies seeking ways of having their small customers send their data in a standardized format. But still the main advantages of EDI as shown in our empirical study – time savings and improvement of business processes – cannot possibly be achieved for both partners since there is no system-to-system communication.

Taking GEIS as an example, the small customer opens an account at GE-TradeWeb. This way, he or she can send EDI messages to the (large) partners via the Web. All communication is based upon HTML-forms. The server-sided translation to EDI format remains invisible to the client; the translation EDI-to-HTML for messages from big to small partner enables the former EDI message to be displayed in the client's browser. But here, the integration stops. The client cannot integrate the 'dead' HTML-coded data into his inhouse systems.

As Jon Bosak, chair of the XML Coordination Group of the W3C, states in his famous article "XML, Java and the future of the web" [Bosak 1997] the eXtensible Markup Language XML has the potential to be the data format of choice used together with the programming language of choice for the Web, Java, to enable the next step in the evolution of EDI. Generally speaking, the use of open standards can considerably reduce the time and money spent on implementing a solution. By avoiding proprietary formats, the danger of investment ruins is decreased and future-oriented solutions can be developed. Especially XML can contribute to the opening of EDI networks. While traditional EDI relationships are often long-term and highly integrated relationships, which are worthwhile only with are large number of transactions and for a long term, the willingness to invest into open, compatible IT-infrastructures is stronger at any point of the Value Chain, especially for smaller partners. Traditionally, the establishment of compatibility between different EDI solution-systems was achieved through deep integration of the EDI standard into the applications of the communication partners. However, on the basis of XML, attempts are now being made to avoid the inflexibility which follows from using data which do not comply with the established in-house-system.

IV AN XML/EDI-PROTOTYPE: LARS-ONLINE

An important use of EDI is the transmission of invoices. It is especially advantageous in the business-to-business area, when for example telecommunication companies or public utility enterprises can offer their customers an invoice such that the important data can be easily and flexibly integrated into the respective inhouse-system. In cooperation with our partner Lufthansa AirPlus we developed an XML-based EDI solution which allows customers of Lufthansa AirPlus to access their invoices via the Internet.

First, invoices in the Lufthansa Airplus-specific invoice-format LARS are converted into XML-documents and saved in an Oracle database. For this purpose, a template containing a dictionary with the properties of the invoice's data fields and the tags and structure of the XML-invoice is used to create an XML-file for prospective presentation in a browser.

All a Lufthansa AirPlus customer needs is a browser, Internet access and a smartcard, which offers access to the Extranet which is based upon a public-key infrastructure with Global Sign being the certificate authority.

A customer who wants to participate in the system gets a Smartcard, containing a personal certificate and a smartcard reader. If customers want to access their invoices, they contact the homepage of AirPlus and identify themselves using the Smartcard. The Webserver checks validity of the certificates and customers' access rights via a directory server giving them access to their respective invoices. The communication is secured using 128-bit SSL.

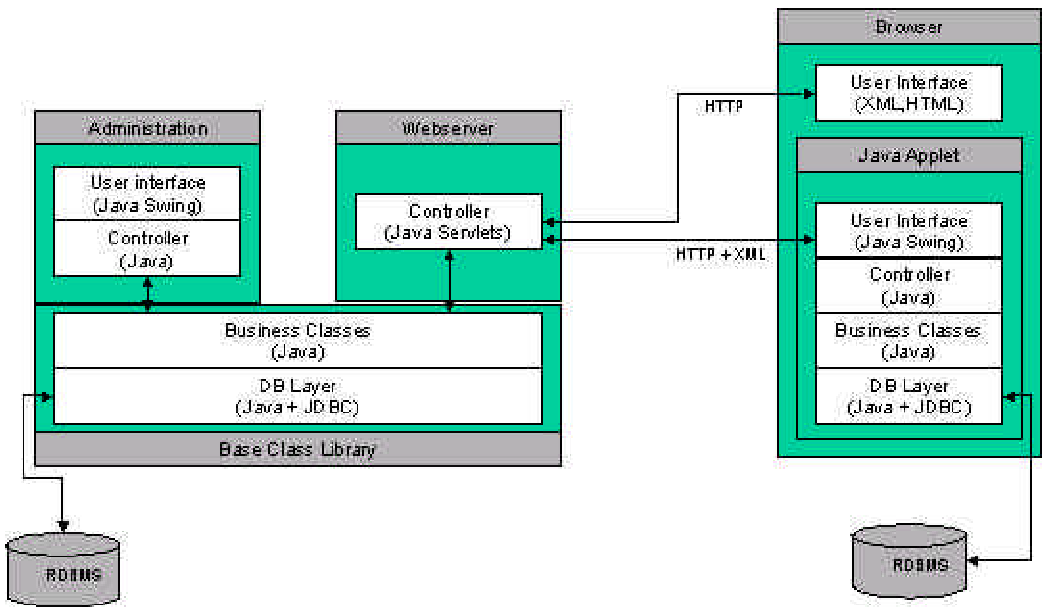

Figure 1: Architecture of the solution

Figure 1 shows the architecture of the solution, which is completely based upon open standards. The left part of the picture, representing the side of Lufthansa Airplus, shows that administration tools are developed using Java. The access from the Webserver to the Relational Database Management System (RDBMS) is realized by Java Servlets due to performance reasons. The right part of the picture shows the client´s side. The client, who receives the invoice, gets the opportunity to view the invoices in his Browser. Furthermore, he can integrate the data into his inhouse systems , e.g. RDBMS or SAP R/3. This integration, again, is realized by using open technologies.

The presentation of the invoice in the browser is made possible using XSL style sheets, in which the layout of the invoice is defined. Since XML distinguishes between data and presentation format invoice data can be adapted to different needs using different style sheets without having to change the XML-file in any way. Ideally, the customer uses an XML-capable browser like Internet Explorer 5 which can directly process the XML-invoice document; alternatively, the XML-file can be rendered to HTML on the server-side using the style sheets and the invoice-file enabling browsers that are not XML-capable to present the invoice anyway.

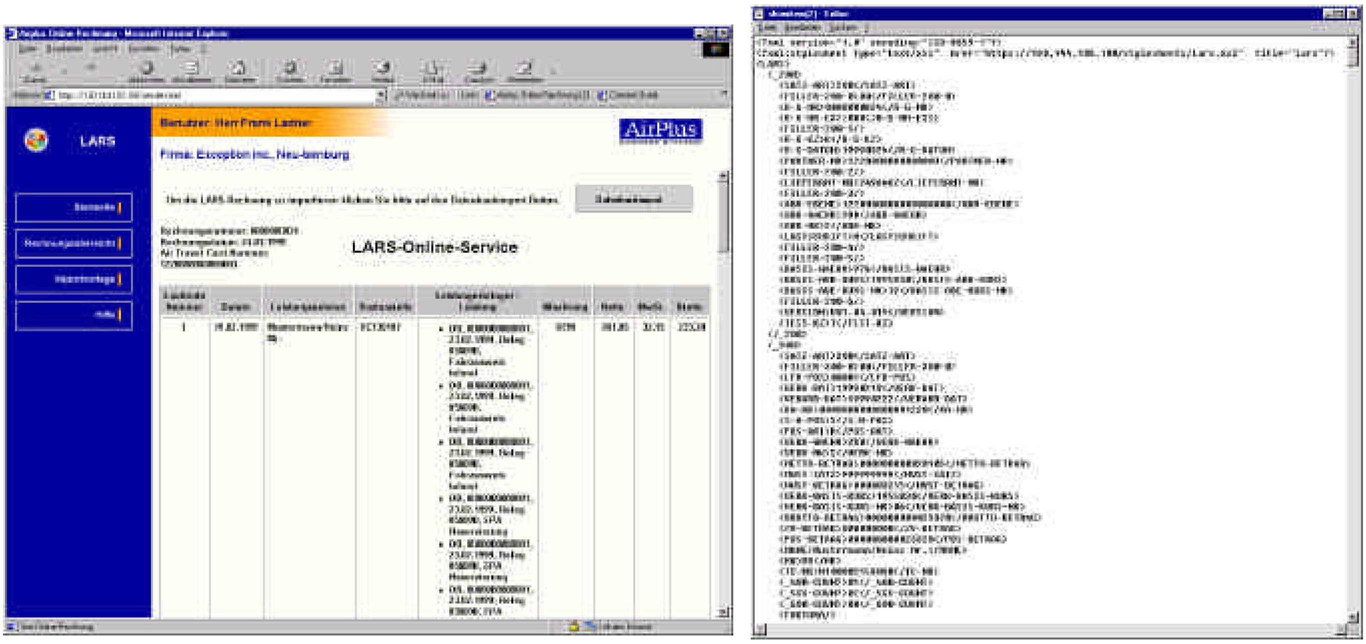

Figure 2: Invoice presented in a browser and as source code

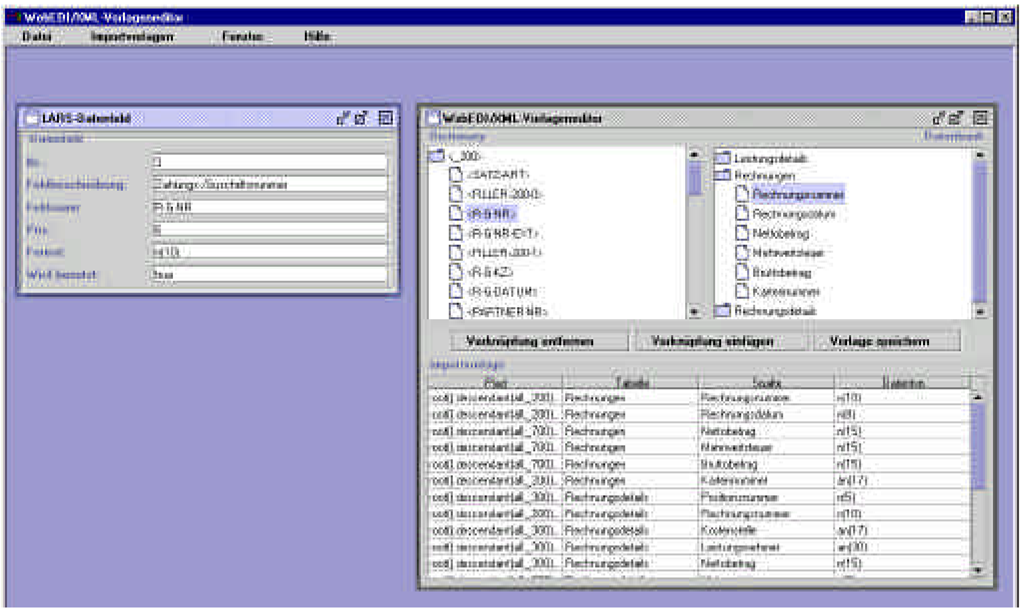

Figure 3: Mapping to inhouse structures

If the customer wishes to import data from the (XML-) invoice into his internal systems, this can be done with the help of a signed Java-applet, which is transmitted together with the invoice. By signing the applet it can individually be granted access to databases outside the Java-sandbox. At mouseclick, the customer can import the defined data from the invoice into a local database. This is possible with all databases for which JDBC or ODBC-drivers are available. Before the first data import, it is necessary to carry out a mapping, in which the customer defines, which data are to be imported into which tables and their fields of the local database. After this mapping is done, any future import will work automatically.

Our mappingtool, which is a Java-applet ready for use on the AirPlus-Server, completely supports a visual mapping. The applet accesses the local database using JDBC to oppose the database structure with the structure of the XML-invoice-format. The dictionary (also an XML-file) that was already used for generating the XML-invoices, contains not only the above mentioned information about the invoice-format but also a description of all invoice elements in explicit and human-readable form, thereby serving as a documentation of the XML-invoice-format. All the customer has to do is map the database field to the respective invoice element he or she wishes to import. An obvious advantage of using XML is the possibility of visualizing metadata as contained in the template in order to assist a user identifying and understanding relevant data fields. A problem that remains unaddressed, of course, is the case of missing data fields, i.e. the client requires a compulsory datum the sender did not include in his message. But this is a general problem of business process integration and not of representing business data in a universal format.

This way, the use of 'full-size EDI' is no longer necessary, when 'custom-size EDI' is to be used. In order to make sure that only meaningful allocations are made, a check of data types and a check of the relations between the tables is performed during this mapping. The result of the mapping is a so-called import-template in XML-format that is stored on the customer's system for later automatic import of invoice data. This template specifies which elements of the (XML-) invoice are imported into which table-fields.

During the import, the applet, which is transmitted together with the invoice, synchronizes the import template and the respective invoice and generates valid SQL-commands for the import by utilizing the relationships between the XML-elements of the invoice. Among other things, XPointers are used during this import, with which single elements of the XML-documents can be selected.

The open architecture of the solution also enables the support of multiple standards. Each of those standards only requires a separate XML document that synchronizes appropriate information in the data fields of the respective standards with the inhouse-system. This way, applications which process documents in foreign formats can understand these documents, even if they only have access to the contents of the communication. Aside from the possibility of supporting different standards, this method enables an easy and flexible alteration of the transaction contents, i. e. the data to be exchanged. The number of business documents the solution is capable of supporting is basically unlimited. For example, product catalogs could be distributed over this architecture. All that is needed is a format dictionary to configure the system for different business documents. The data source is not necessarily some particular inhouse format like LARS but can also be any database or a SAP-system, for example.

V CONCLUSION

While traditional EDI offers considerable potentials for many larger enterprises, it is not as widespread as many had expected. Especially small and mid-sized firms often name the high costs of implementing and running EDI as dissuading factors. Furthermore, many of today's solutions are platform dependent, meaning additional investments in both hardware and software. Thus, according to J. P. Morgan, 98 % of all non Fortune 1,000 companies do not use EDI [Densmore 1998].

A first step towards addressing the high up-front and operating costs is using the Internet and new surrounding technologies as a medium for EDI communications. Form-based EDI offers an easy and inexpensive way of enabling a one-sided opening of networks.

The XML/EDI-prototype we introduced enables the efficient integration of partners into existing EDI networks. Based upon the ubiquitous infrastructure of the Internet all a participating actor within the secure extranet needs is a webbrowser. In order to achieve compatibility such that EDI data in foreign formats can automatically be imported into one's inhouse systems all that has to be done is a visually supported one-time mapping of the relevant data to respective fields of a local database. The architecture of the solution makes a simple support of different standards possible. Just like the LARS-template, an XML-document as a result of the mapping is used as a template for any future communication with the users of the corresponding standard. In a very efficient and flexible way any transaction content can be altered and adapted to different needs because semantics and structure are no longer hard-coded part of the application but of the exchanged XML-document.

The LARS example shows the enormous potential that lies in the use of XML as data format in combination with other open Web standards such as Java. Millions of webusers are empowered to open new dynamic EDI networks or to participate in existing networks even though they do not carry out large numbers of transactions in long term relationships. Although some doubt if such solutions can be called 'EDI' anymore for they miss THE standard, basically it is EDI, it is the electronic exchange of business data between systems while avoiding proprietary standards. The benefit of XML is taking the standard out of the application and into more easily manageable (external) documents. "Java software is portable code ... XML is portable data" [Brownell 1998].

REFERENCES:

Bosak, J. (1997): XML, Java and the future of the Web. http://sunsite.unc.edu/pub/sun-info/standards/xml/why/xmlapps.html

Brownell, D. (1998): XML and Java Technology, An Interview with Dave Brownell, http://www.webpaulo.com/html/xml_and_java.html

Curtis, C. (1996): EDI over the Internet: Let the games begin, in: Internetweek, Issue 627, Sept. 9, 1996, http://www.techweb.com/se/directlink.cgi?CWK19960909S0076

Densmore, B. (1998): EDI vs. The new kids, in: Computerworld, April 6, 1998, http://www.computerworld.com/home/Emmerce.nsf/All/980406edi

Emmelhainz, M. (1993): EDI: A Total Management Guide, New York 1993

Marcella, A./Chan, S. (1993): EDI Security, Control, and Audit, Norwood 1993

Segev, A./Porra, J./Roldan, M. (1997): Internet-Based EDI Strategy, working paper 97-WP-1021, http://haas.berkeley.edu/~citm/wp-1021.pdf

Waltner, C. (1997): EDI Travels The Web - EDI over the Web offers companies cheaper E-commerce and messaging via browsers, in: Internetweek, Issue 668, June 16, 1997, http://www.techweb.com/se/directlink.cgi?CWK19970616S0066

Westarp, F. v./Weitzel, T./Buxmann, P./König, W. (1999): The Status Quo and the Future of EDI, in: Proceedings of the 1999 European Conference on Information Systems (ECIS' 99), http://caladan.wiwi.uni-frankfurt.de/IWI/projectb3/deu/publikat/edi/